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THE MOLLUSCAN FAUNA OF THE GENESEE RIVER.

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THE study of faunal distribution has always been a favorite occupation of zoölogists, and particularly of those interested in the study of the Mollusca, as in this branch we find a very large number of species, covering wide areas and subject to every variation of environment. In no department of the Mollusca is this of such absorbing interest as in the fresh-water forms (unless we except, perhaps, the air-breathing pulmonates), especially those inhabiting a large river where there are several barriers to the homogeneous distribution of its shell fauna. During the past summer the writer spent several months in such a study of the Genesee River, where the environments are quite different in several parts of the stream, with a corresponding difference in the mollusk fauna. The river was carefully surveyed from near its mouth on Lake Ontario to beyond South Park, a distance of ten miles. A large collection was made, which is now in the museum of the Chicago Academy of Sciences. My thanks are due to Miss Edna E. Hall for valuable assistance in collecting, and to Rev. John Walton for many notes.

The Genesee River rises in Potter County, Pennsylvania, and flows in a generally northward direction for about 120 miles, emptying into Lake Ontario, seven miles north of Rochester, N. Y. The Genesee valley is very fertile, and the river flows between low banks rich in vegetation. Before passing Rochester the river is deep, the banks muddy, and the current steady but not very swift. From a point a little north of Genesee Valley Park (or South Park) the bottom of the river becomes very rocky, the current swift, and at Rochester the river drops to the valley below in three series of falls of considerable magnitude.

The geography of the river from South Park to the lake may be thus described: From south of Genesee Park to within a short distance of a small dam it is broad, deep on one side and affording a shelving, shallow bank on the other, the bottom being composed of a clayey mud. Unios, Campelomæ, Goniobases, Sphæria, and Physæ are here very common. Just before reaching the dam the river shallows very perceptibly, flowing rapidly over great ledges of limestone. *Lampsilis luteolus* and *L. iris* are very common here, and also Goniobasis, while Physa is not quite so common.

Below the dam, which is now broken and very much out of repair, the river flows rapidly over a rocky bed, in many places the water being so shallow that persons can wade across. The right bank is very rocky, more so than the left, and forms little sheltered bays here and there, in which Goniobasis and Physa live by thousands, the former making a veritable pavement in some places. *Lampsilis luteolus* is also common, although apparently preferring the middle of the river. Along the bank here the Unios lie in great windrows, their dead shells piled up like the débris on an ocean shore. In this pile of shells such species as *Lampsilis iris*, *L. luteolus*, *Quadrula rubiginosa*, *Lampsilis complanatus*, and *Alasmodonta rugosa* are common. The water near the rocky shore also affords good retreats for the mollusks.

Near the Erie Railroad bridge the water deepens, and the Unios begin to thin out, although *Lampsilis luteolus* seems to be as common as ever. Goniobasis also flourishes, while Physa almost dies out. Near Clarissa Street bridge the water becomes still deeper, and the only species found are *Lampsilis luteolus*, *L. iris*, *L. complanatus*, and Goniobasis, with a stray Campeloma or Sphærium. Physa seems to have disappeared completely. Below Clarissa Street bridge the water deepens to the state dam, beyond which it is very shallow and rocky, so far as known affording no mollusks save an occasional Goniobasis or Campeloma. At the dam the water is deflected in a large stream for factory uses and again reaches the river at the first falls.

At Rochester, below the bridge of the New York Central Railroad, the river drops to the valley below in a fall 96 feet in height, cutting through Niagara limestone and Clinton shale. Below this fall the current is rapid, the river flowing in a sinuous course, leaving on either side at intervals a low, flat piece of ground with a shallow, shelving shore, the opposite side, however, being very deep. The upper part of the river is so contaminated with oil and gas products from the gas works and a number of manufactories that mollusks cannot live here. A short distance down the river, where the water is not so badly contaminated, a few Physæ, Planorbis, and Limnæa live. These grow more abundant as the purer waters are reached. About two miles farther north a second fall occurs, 26 feet in height, cutting through the Clinton shale. Below this fall the river runs swiftly, is very deep, and forms a circular pool just beneath the fall. The walls are very steep and stony, the river having cut away the soft shale, leaving great projecting ledges. Physa, Planorbis, and Limnæa are here notably abundant, living on ledges of rock where the water is a few inches deep.

A few hundred feet north of this fall a third one occurs, cutting through Medina sandstone 83 feet in height, and the river drops to the valley below, flowing at first rather rapidly, but after a mile or so rather quietly, between well-wooded banks 210 feet in height. The river is here bordered by many swampy flats covered with rank vegetation, and the shores are muddy. Near the falls the river is somewhat shallow, flowing over fallen rocks, but it soon becomes quite deep. The genera present are Limnæa, Physa, Planorbis, Bythinia, and Calyculina; Limnæa and Planorbis predominating. In the mouth of the Genesee there are some eight or ten species of Unios, with some gastropods, which have come in from Lake Ontario, but they have not as yet reached far enough up the river to form a factor in this discussion.

The following table shows the comparative distribution of the species in each section of the river. An asterisk (*) indicates that the species is very abundant, while the dagger (†) shows that the species is more rarely found.

TABLE OF COMPARATIVE DISTRIBUTION.

ABOVE FIRST FALLS.	BETWEEN FIRST AND SECOND FALLS.	BETWEEN SECOND AND THIRD FALLS.	LOWER RIVER.
Planorbis trivolvis *	Planorbis trivolvis *	Planorbis trivolvis *	Planorbis trivolvis *
Limnæa palustris †		Limnæa palustris †	
	Limnæa catascopium *	Limnæa catascopium *	Limnæa catascopium *
	Limnæa caperata †	Limnæ caperata †	Limnæa caperata †
Ancylus rivularis †			
Physa integra *		Physa integra †	
	Physa sayii *	Physa sayii *	Physa sayii *
			Physa gyrina *
			Physa heterostropha †
			Bythinia tentaculata
Goniobasis livescens *			
Campeloma rufum *			
Campeloma decisum *			
Campeloma integrum †			
Calyculina transversa †			Calyculina transversa *
		Calyculina partumeia †	Calyculina partumeia †
Sphærium simile *			
Sphærium stamineum *			
Anodonta lewisii †			
Alasmodonta pressa *			
Alasmodonta rugosa *			
Alasmodonta deltoidea †			
Alasmodonta marginata †			
Strophitus edentulus *			
Anodontopsis ferussacianus †			
Quadrula rubiginosa *			
Quadrula undulata †			
Lampsilis iris *			
Lampsilis luteolus *			
Lampsilis ventricosus †			
Lampsilis alatus †			
Lampsilis radiatus †			
Lampsilis complanatus *			
Lampsilis tappanianus †			

A study of the table will show a few interesting facts. The first will be the abundance of Unios above the falls and their total absence below, showing that the upper falls afford an insurmountable barrier to their further distribution in this direction. Another fact of equal note is the abundance of certain gastropods in all four sections of the river (Planorbis, Physa). The general absence of ctenobranchiates below the falls (Bythinia excepted) is noteworthy. Bythinia is a recent addition to the fauna of the lower river, appearing in immense numbers in 1898. It was very common at the mouth of the river, in Lake Ontario, in 1895, and in these three years it became one of the most abundant mollusks in the lower river.

The distribution of Physa is also peculiar. *Physa integra* is the dominant and (so far as I know) the only form above the falls, and *Physa gyrina* below. *Physa sayii* is the only species between falls 1 and 2 and is very abundant only between the upper and lower falls, a very peculiar distribution, for which I cannot account. *P. integra* does not occur between the upper river and falls 2 and 3, and I was not able to find it between falls 1 and 2, which, if borne out by future observations, offers an interesting phase of distribution. Why *P. integra* should be so interrupted in its distribution may be accounted for by two hypotheses : (1) that specimens may have been carried over the first and second falls and found lodgment above the lower falls; or (2) specimens might have been carried by birds or other animals. Why *Physa sayii* is found everywhere except in the upper river is also an interesting question.

Limnæa seems to be evenly distributed, and yet in this genus we find the same peculiar distribution as in Physa. *L. palustris* has been collected in small numbers in the upper river, but *L. catascopium* and *L. caperata* take its place in the other three regions, the former being very abundant. Ancylus has been found only in the upper river, in the dead valves of Unios, but it may be that it inhabits all parts of the river. As in the case of *Physa integra*, we find the distribution of *Limnæa palustris* to be peculiar, jumping, as it does, the first fall and occurring sparingly between falls 2 and 3. *Planorbis trivolvis* is the only evenly distributed species. Among the bivalves, *Calyculina transversa* is interrupted in its distribution, but, like *Physa gyrina*, *P. heterostropha*, and *Bythinia tentaculata*, may have come up the river from Lake Ontario. This, however, will hardly account for *Calyculina partumeia*, which is found in the lower river and between falls 2 and 3.

As one glances over the table the fact presents itself that there is a marked division in the faunas between the upper river and the series of falls, and the lower river. This may be accounted for by the fact that for a distance of about two miles above the first fall the river is shallow and very rocky, in fact flowing over great ledges of Niagara limestone, and the Unios all seem to prefer the deeper, more quiet waters above this section of the river, only a few stragglers, like *Lampsilis luteolus*, *L. iris*, and *Alasmodonta rugosa*, being found in this rocky region. The writer was unable to find Unios within a half mile of the upper falls, showing conclusively that this environment is unsuitable for them. Another reason why Unios are not found below the falls is probably that their heavy shells and also their habit of burying themselves in the mud prevent them from rising to the surface and being swept over the falls, as might be the case with Planorbis, Limnæa, or Physa, which come periodically to the surface for air.

The foregoing discussion indicates that a series of falls like those at Rochester will prove an effective barrier to the distribution of some mollusks (as the pelecypods with mud-burrowing habits and the ctenobranchs, which cling to the rocks and do not come to the surface), while to others (like the fresh-water pulmonates, which come to the surface frequently and hence could be swept over the falls) it is not a barrier. Future studies and collections, however, may modify the above conclusions.